BRA
632

urier
s, Inc

TABLE OF CONTENTS

	Pages
Introduction	1
Geological History of Back Bay	1
Recent History of Back Bay	2
Soil Conditions	2
Groundwater Conditions	2
Foundation Conditions	3
Implications for Present Construction	3
Guide lines for Future Construction	3
Recommendations for Further Investigation	4
Appendix I Outline	5, 6, 7, 8
Appendix II Partial Bibliography	9

Back Bay
L543 P

A38
C30

**LeMessurier
Associates, Inc**

TABLE OF CONTENTS

	Pages
Introduction	1
Geological History of Back Bay	1
Recent History of Back Bay	2
Soil Conditions	2
Groundwater Conditions	2
Foundation Conditions	3
Implications for Present Construction	3
Guide lines for Future Construction	3
Recommendations for Further Investigation	4
Appendix I Outline	5, 6, 7, 8
Appendix II Partial Bibliography	9

Preliminary Progress Report

on

Study on Foundation Conditions in Back Bay

I. Introduction

This report will outline the progress of the study of foundation conditions in the Back Bay area and indicate, where possible, the preliminary conclusions which are being reached. The ultimate objective of the study is threefold; namely to define soil and groundwater conditions in the Back Bay, to describe the present general condition and estimate the probable life expectancy of the foundations of existing structures, and to formulate general foundation design principles to guide future development.

The procedure which is being followed is to gather available data on soil and groundwater conditions in the Back Bay, together with case histories of the design and construction of structures in the area; there is a wealth of this data in existence although it has never been systematically collected and synthesized. The sources of the data vary from published technical papers to word-of-mouth; some members of the Corporation have excellent unpublished technical data in their files, and Mr. Ahern is assisting us in gaining access to this information.

We intend to organize and present this data in accordance with the outline attached to this report. This preliminary report is organized in the same form, and the sources which have been contacted are indicated. A partial list of the published data which has been reviewed is indicated on the attached bibliography. We request that members of the Corporation and other interested parties examine the sources of information which are being contacted or consulted and suggest other sources which may be unknown to us.

II. Geological History of Back Bay

The soil, rock and groundwater conditions of an area are largely a function of its geological history. By the same token, the geological history provides the framework on which one builds a general picture of conditions from bits of isolated data. A review of the geology of the Boston area

is therefore an essential part of this study. Publications by Johnson et alia on the Boylston Street Fishweir provide excellent summaries of the geology of the Boston area, and this information is being supplemented by discussion with Mr. C. Kaye who has been studying the surficial geology of Boston for some years for the U. S. Geological Survey. The sequence of geological events is listed on the attached outline.

III. Recent History of Back Bay

The term "recent" is used with respect to geological time and applies to the activities of man in the Back Bay since the settlement of Boston in the 17th century. Of particular importance to this study is the record of filling in the Back Bay during the late 19th century and subsequent construction activity for the period extending into the early 20th century. An excellent general source of information is Whitehill's "Boston, A Topographical History". However, more detailed information is urgently required, especially on foundation construction practice.

IV. Soil Conditions

The soil conditions in the Back Bay are being compiled from the records of the Boston Society of Civil Engineers, the files of the U. S. Geological Survey and from unpublished reports and drilling logs of various engineers and contractors. This information together with data on soil properties will be discussed in the report and will also be shown graphically on 5 sections taken along Beacon Street, Commonwealth Avenue, Boylston Street, Stewart Street (extended) and Chandler Street (extended). These sections are presently in rough form and are being refined and redrawn for final reproduction.

V. Groundwater Conditions

Groundwater conditions are of crucial importance and more information is urgently required. There are, briefly, two conditions of importance. The first is groundwater levels in the materials overlying the thick bed of clay which generally underlies the whole area; this is of extreme importance to the future of older structures in the area which are founded on wood piles. The second important condition is the level of groundwater at the base of the clay. Because of the membrane effect of the clay layer these can be quite different from the water levels above the clay and there are scattered indications that these levels may be of the order of 20 feet below those above the clay. There is also some evidence that these levels have dropped perhaps

as much as 30 feet over the past few decades, possibly due to pumping from industrial water wells in the area. The importance of falling water levels below the clay is that regional subsidence is induced due to consolidation of the lower levels of the clay stratum. It has been suggested by Casagrande that the rate of subsidence in the Back Bay due to this cause is of the order of 1/16 inch per year. If water levels continue to decrease, the rate will increase.

The following information would be helpful:

1. Records of water levels in observation wells installed above the top of the clay. We have seen records from Trinity Church and the Boston Public Library as well as records published in 1894 by a committee concerned with development of the Charles River Basin.

2. Records of water levels beneath the clay. We have seen a summary of observations made in 1957 at the Prudential site. Others may be available from John Hancock and New England Mutual.

3. The presence of deep industrial wells in the area or nearby and their location, details of pumping and observations of water levels.

VI. Foundation Conditions

The fill and organic deposits constitute unreliable foundation bearing strata. Building loads therefore must be transferred at least to the sand and gravel or to the top of the clay by the methods indicated in the outline. For buildings larger than about 10 stories, it is usually necessary to go through the clay to the underlying dense glacial till or bedrock. These various alternatives will be discussed in detail in the final report.

VII. Implications for Present Construction

We wish to reserve comment on this matter until more information has been gathered on groundwater conditions and the records of existing construction.

III. Guide lines for Future Construction

We wish to defer this matter as well until there has been opportunity to discuss the possible types of development which should be considered.

IX. Recommendations for Further Investigation

Discussion on this would be premature. However, it seems certain that further study of groundwater levels and the problem of regional subsidence will be indicated.

AAG:crw

Appendix I

Outline

Outline for Report on Study of Back Bay Foundation Conditions

I. Introduction

- A. Terms of Reference
    - 1. Soil and Groundwater Conditions
    - 2. Future of Existing Construction
    - 3. Guide lines for Future Construction
- B. Procedure
    - 1. Sources of Data
    - 2. Synthesis of Existing Data
    - 3. Investigation of Representative Models

II. Geological History of Boston Area

- A. Bedrock, Subsequent Erosion
- B. Glacial Advances - Scour and Deposition of Till
- C. Deposition of Clay - Brackish Environment
- D. Changes in Sea Level - Desiccation of Clay, Erosion
- E. Deposition of Sand and Gravel Outwash
- F. Recent Swamp Deposits
- G. Man-made fill - 19th Century

III. Recent History of Back Bay

- A. Settlement in 17th Century
- B. Mill Ponds
- C. Railway Embankments
- D. Filling in of Back Bay
- E. History of Construction

IV. Soil Conditions

- A. Rock
- B. Till
- C. Clay
- D. Sand and Gravel
- E. Organic Deposits
- F. Fill

V. Groundwater Conditions

- A. Above Clay
- B. Below Clay
- C. In Clay

VI. Foundation Conditions

- A. Relatively Light Buildings (10 Stories or Less)
    - 1. Piles or Piers to Sand and Gravel
    - 2. Piles or Piers to Hard Clay Crust
    - 3. Piles or Piers to Till or Rock
    - 4. Float
- B. Large Heavy Buildings (Greater than 10 Stories)
    - 1. Usually must go to till or rock
    - 2. Possible to float in some uses

VII. Implications for Present Construction

- A. Types of Foundations
    - 1. 19th, early 20th - Wood piles
    - 2. Early 20th to Present
        - a) Light Buildings - piers or piles to top of clay or sand and gravel
        - b) Large Buildings - piles or caissons to rock - rare float.

VII. Implications for Present Construction (Continued)

B. Wood Pile Foundations

1. O K where groundwater levels have remained high
2. Destructive rot when groundwater levels drop
3. Future

C. Regional Subsidence

1. Due to compression of peat - approximately 1/16"/year
2. Due to consolidation of lower clay because of lowered G.W.L. in rock - approximately 1/16"/year
3. Total Subsidence of Ground Surface - approximately 1/8"/year - unsightly
    a) Buildings on Piles to Rock most affected
    b) Buildings on Short Units less affected
    c) Streets, sidewalks affected - ultimately sewers
    d) More information needed

D. Entrapment of Gases from Organic Deposits

1. No instances on record known
2. Examination of possibility

VIII. Guide lines for Future Construction

A. Require assistance of Corporation and consultants to set up models of the possible types of future development which should be studied. Given this

VIII. Guide lines for Future Construction (Continued)

A. ...information, will make computations to show impact of various foundation systems on cost of construction and how impact varies with size of development. Discussion of other factors such as cost of excavation, effect on adjacent structures, etc.

IX. Recommendations for Further Investigation

A. Groundwater levels - above and below clay

B. Regional Subsidence

AAG:crw

Appendix II

Partial Bibliography

Partial Bibliography

Aldrich, H. P., Jr. (1952) "Importance of the Net Load to the Settlement of Buildings in Boston" Journal BSCE Vol. XXXIX No. 2.

Casagrande, A. (1947) "The Pile Foundation for the New John Hancock Building in Boston" Journal BSCE, Vol. XXXIV No. 4.

Casagrande, A. and L. (1958) "Report to Metcalf and Eddy, Engineers on Foundation Investigation for Prudential Center in Boston Vol. I" (Unpublished).

Casagrande, A. and Fadum, R. E. (1944) "Application of Soil Mechanics in Designing Building Foundations" Trans. ASCE, Vol. 109, Paper No. 2213.

Johnson, F. et alia (1942) "The Boylston Street Fishweir" Papers of the Robert S. Peabody Foundation for Archaeology, Vol. 2.

Johnson, F. et alia (1949) "The Boylston Street Fishweir II" Papers of the Robert S. Peabody Foundation for Archaeology, Vol. 4, No. 1.

Paine, R. T. (1935) "Trinity Church in the City of Boston, The Church Endangered by the Low Level of the Ground Water, How the Danger has been Temporarily Averted" (Privately Published by Trinity Church).

Taylor, D. W. (1944) "An Unusual Foundation Problem, The Alumni Pool Building" Journal BSCE, Vol. XXXI, No. 4.

Whitehill, N. M. (1963) "Boston, A Topographical History" Belknap Press of Harvard University Press

-- (1894) "Report of the Joint Board consisting of the Metropolitan Park Commission and the State Board of Health upon the Improvement of Charles River" House No. 775.

AAG:crw

LeMessurier Associates, Inc

William J. LeMessurier
William L. Thoen
Emil C. Hervol

Consulting Engineers 711 Boylston St. Boston, Mass. 02116 262-9300

gm 96-1-576

"BOSTON PUBLIC LIBRARY"

Property of
BOSTON REDEVELOPMENT AUTHORITY
Library

PRELIMINARY PROGRESS REPORT

TO

BACK BAY PLANNING AND DEVELOPMENT
CORPORATION

ON

STUDY OF FOUNDATION CONDITIONS IN BACK BAY

BOSTON MASSACHUSETTS

Distribution:

~~50~~ 12 copies - Back Bay Planning and Development Corporation

January, 1966 6529

BOSTON PUBLIC LIBRARY
3 9999 06314 703 5

L543P

Study of Foundation Conditions in

BACK BAY

DATE	ISSUED TO